Silicon Valley: Transportation Advancements and the Interactive Megalopolis

a report by

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Introduction

This article challenges the way in which we look at cities as they evolve in response to rapidly changing labour requirements for the knowledge worker, new telecoms technologies, and the resulting requirements and implications for the transportation infrastructure.

In the information age, the evolved urban form will be the' Interactive Megalopolis', merged metropolitan regions that form a single network defined by the distance that workers are able to overcome to access greater employment opportunities while retaining or improving their quality of life.

While innovative telecoms advancements are being celebrated almost daily, we seem unable to usher in new radical innovations beyond traditional transportation modes, whether they may be the metropolitan commuting automobile, the inter-metropolitan air service or financially struggling mass transit commuting. Even for the virtual information/telecoms industry, physical transportation will remain an important factor in knowledge labour recruitment and the defining characteristic in determining the physical limits of technopoles.

Virtual Access and the Paradox of Location Behaviour

One of the difficulties that transportation planners face is the illusion that the requirement for transportation developments is lessening because of the ability of technology industries to exploit telecommunication advancements to defy geography. As a result, the need to increase the capacity of current transportation systems is far easier to demonstrate than the requirement of extending the range of mass transportation systems, whether the automobile or collective ground mass transit alternatives. This assumption will not serve the interests of the fast-growing economy in the US and elsewhere.

The executives of technology industries understand that the 'time-to-market' pressure has forced them to locate within metropolitan clusters called 'technopoles'. This seemingly contradictory location behaviour reveals the greatest contradiction concerning the exaggerated demise of distance attributed to telecoms: physical accessibility does matter.

Technopole Location Attributes

The Conference Board of Canada examined the spatial clustering of knowledge-based industries. They surveyed 12 technopole companies around the world to determine the three most important factors in order of importance that determine location behaviour:[1]

1. access to a skilled labour force;
2. quality of life; and
3. access to a local R&D university.

These factors were consistently shared internationally, including Silicon Valley, inspiring a recommendation that governments focus their efforts and invest in programmes that would strengthen these attributes.

The results of this survey and countless others reflect a fundamental urban planning tenet: "Cities are primarily a place to work and a place to live". While these attributes are forever linked, they can at the same time be in serious conflict. While one requires higher concentrations of urban populations, the second can be adversely affected by growing urban populations with dire consequences for feasible commuting distances, congestion and local housing prices. This conflict will result in higher transportation infrastructure and operating costs and negative environmental impacts.

Silicon Valley: Conflicting Demands of Metropolitan Labour Accessibility

In the Knowledge Base Society, the conflict between quality of life and the need for increased

1. *The Conference Board of Canada by J Zieminski and Warda, "What Makes Technopoles Tick?", Ottawa, September 1997.*

agglomerations of labour skills can be pronounced. Silicon Valley stands as an undeniable example of this conflict. When millionaires are created every week in Silicon Valley, the purchasing power of a million dollars diminishes and workers are less able to find affordable housing.

Silicon Valley Joint Venture

Silicon Valley and Ottawa, Canada, represent the opposite ends of this spectrum. While Ottawa extols the virtues of quality of life to attract companies, these companies must evaluate the cost of locating in a region where an urban population of one million residents may not be large enough to sustain them with a continuing pool of knowledge workers. At the same time, companies evaluating a move to Silicon Valley know that their labour costs will be significantly greater to offset the cost of living, which is the highest in the US – 37% above the national average.[2]

The effective management of knowledge – that is, the organisational capability to create, acquire, accumulate and exploit knowledge – is increasingly a source of competitive advantage. Global firms source, produce and distribute their products worldwide, continuously striving to minimise their costs and maximise their profits. Robert Reich the former US Secretary of Labor, correctly observed that, "Labor shortages rarely mean that workers cannot be found at any price. A more accurate meaning is that desired workers cannot be found at the price that employers and customers wish to pay."[3]

Annual Labour Cost Impact

Silicon Valley employers incur a total annual incremental labour cost of US$3 to US$4 billion in salary premiums, turnover costs, productivity loss/ opportunity costs and hiring costs because of a growing workforce gap for skilled workers.

These incremental costs are the result of the imbalance between the local availability of skilled labour and the total demand for skilled workers. The local labour market is able to provide 63% to 69% of the skilled talent needed in Silicon Valley. Of the remaining positions: 5% to 7% go unfilled; 10% to 12% are filled by outside recruits relocating into the valley; and 16% to 18% are filled by workers who commute long distances from outside Silicon Valley. Employers identified three key problem areas arising from this shortage:

1. a limited supply of qualified candidates;

2. high housing costs in the valley that compromise the attraction and retention of talent; and

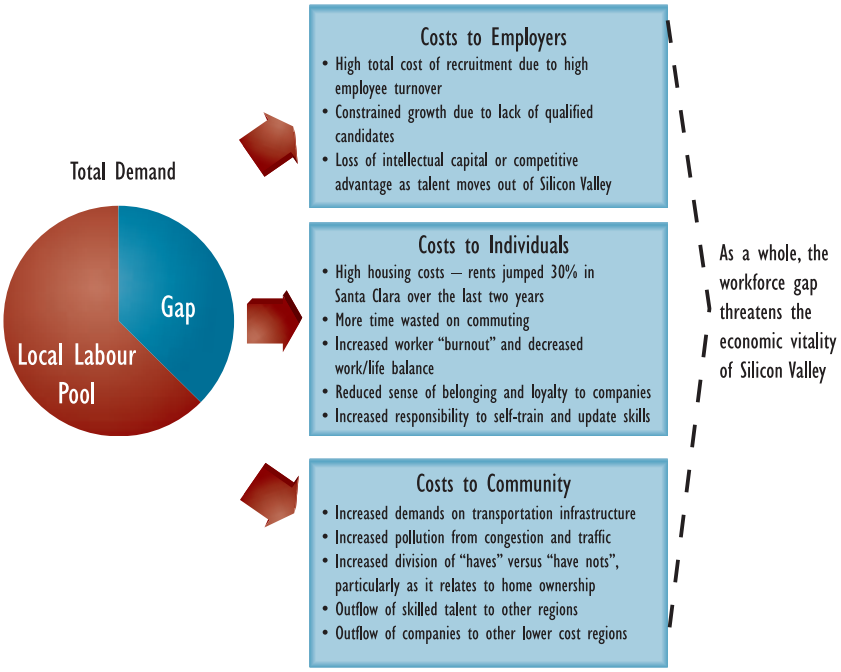
3. the associated requirement for higher wages impeding small and medium-size companies' ability to hire.[4]

The continued success of Silicon Valley will depend on the ability of the region to attract and maintain skilled knowledge workers. But the very success of Silicon Valley is contributing to rising employment costs from the congestion that such a large agglomeration of skilled workers creates. The annual incremental employment cost of US$3 to US$4 billion is a conservative estimate. Even today's employment cost excludes other costs that have not been quantified (see *Figure 1*). The combined impact of the workforce gap is staggering and employment forecasts indicate even greater difficulties.

Between 1992 and 1999, 275,000 new jobs were created in Silicon Valley, yet only 54,600 new housing units were built, representing a ratio of one new housing unit for every five new jobs.[5] Despite all attempts to increase housing stock, "There is no conceivable way that supply could meet demand,"

2. *"A Hard Look at Silicon Valley's Boom", Mercury News Special Report: www.sjmercury.com/svtech/news/special/wealth/docs/cost1*
3. *Robert B Reich,* The Work of Nations: Preparing ourselves for 21st century capitalism, *Alfred A. Knopf Inc., New York, 1991.*
4. *A T Kearney, "Joint Venture Workforce Study: An Analysis of the Workforce Gap in Silicon Valley", www.jointventure.org, 1999.*

Figure 1: Employment Cost



Work-force shortages in Silicon Valley drive significant costs to employers, individuals and the community.

Source: A T Kearney.

says Frank Lockfeld, director of the County of Santa Clara's Center for Urban Analysis.[6]

Rental housing has even become less accessible. From 1993 to 1997, the cost of rental housing in Santa Clara grew by 29% after adjusting for inflation, while household income grew 11%. Among the jobs that typically do not pay enough are pharmacy technicians, dietitians and elementary school teachers. A department store sales clerk would have to work more than 112 hours per week, every week, to afford rental accommodation. The response is predictable: people are leaving Silicon Valley for more affordable communities such as Tracy, Modesto and Stockton. Those who keep their jobs, take on daunting commutes.[7]

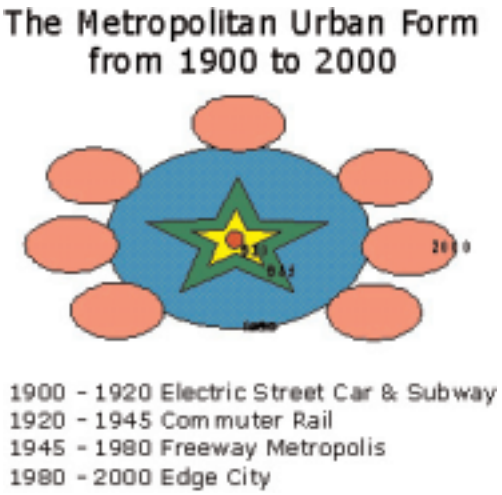
Over 1,600 years ago, Rome with an estimated population of 1.5 million become so congested that transportation, housing and waste disposal systems collapsed under the strain.[8] Today, unable to accommodate a wealthy population of 2.5 million, Silicon Valley is suffering a competitive disadvantage that threatens its place in the new economy.

The Federal Transit Administration is funding an 8.2-mile extension to the BART system that will run the line south from Coloma Station to San Francisco International Airport. The total cost of the project will be US$1.5 billion or US$185 million for every extended mile. While this investment will improve ground airport access, the extension will not alleviate the congestion in Silicon Valley.[9]

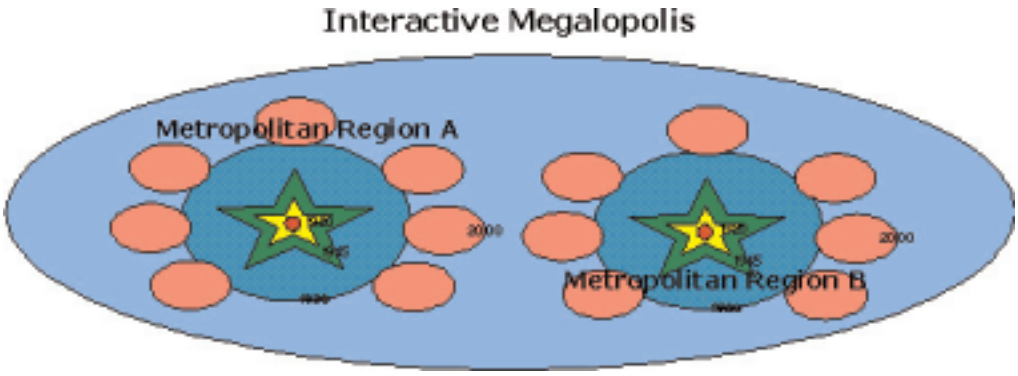
Do we have to choose between economic growth and quality of life? No, we do not, but only if we turn the page on the metropolitan urban form by leaving it in the industrial age and begin building the Interactive Megalopolis.

The Evolving Urban Form

The 20th century has shown that the urban form is not and never has been a static human settlement pattern. It alters its shape to conform to changing economies and advancing transportation and telecoms technologies. While state and local governments are defined by legal boundaries, urban areas are shaped by local economic activities that thwart local and even state limits. This economic dynamism and creativity contribute to the nation's economic development and its competitiveness in the global economy. In transportation planning terms, the local economic activity range is equated to commuter-sheds, the distance at which workers are able to separate their places of work and residence.
In 1900, the introduction of the telephone and



5. *A T Kearney, "Joint Venture Workforce Study: An Analysis of the Workforce Gap in Silicon Valley", www.jointventure.org, 1999*
6. *"A Hard Look at Silicon Valley's Boom", Mercury News Special Report: www.sjmercury.com/svtech/news/special/wealth/docs/cost1*
7. *"A Hard Look at Silicon Valley's Boom", Mercury News Special Report: www.sjmercury.com/svtech/news/special/wealth/docs/cost1*
8. *A Gallion and S Eisner,* The Urban Pattern: City Planning and Design*, D.Nostrand Company, 1975.*
9. *Federal Transit Administration, BART Extension to San Francisco International Airport, November 1999, www.fta. dot.gov/library/policy/ns/ns2000/sfbartair.htm*



electric streetcars in urban America and, in New York (1904) the subway, expanded the range in radial patterns. Fast and frequent electric streetcars tripled the speed of horse trolley and pedestrian travel to 15 miles per hour and brought into production vacant lands for residential use. In New York City, with subway speeds in excess of 30 miles per hour, urban expansion consolidated the five boroughs to form a single metropolitan area.

By 1945, the matured commuter rail system further expanded the city by reaching into distant towns in a radial pattern. Urban and transportation planning attempts to plan for this new expanded urban form were hampered by the inability to distinguish between rural and urban areas and to classify travel as either urban or rural. The ability to plan for the new urban form improved dramatically when planners recognised the evolving urban form as the emerging Metropolis. Trips between Concord and Boston in Massachusetts, for example, were now considered to be metropolitan urban.

Thirty-five years later, the completed freeway system offered ubiquitous accessibility to an expanded urban form of 50 miles or so in radius, giving birth to the freeway metropolis and suburban tract developments. Beginning in the 1950s, its most lasting social and economic achievement was the provision of affordable home ownership for middle-class America.

The last transformation is the emergence of 'Edge Cities', as described by Joel Garreau.[10] These new Edge Cities at the peripheries of metropolitan limits facilitated the creation of high-tech industries for the new economy. Joel Garreau identified 12 Edge Cities in the Bay Area: San Rafael; Daly City; San Mateo; Redwood City; Sunnyvale; San Jose; Dublin/ Pleasanton; Berkeley; Bishop Ranch; Walnut Creek; Pleasant Hill; and Concord. With the current transportation infrastructure, Silicon Valley is able to encompass San Jose, Sunnyvale, Redwood City, San Mateo and Daly City, but it is becoming increasingly difficult for Silicon Valley employers to reach into San Francisco, Oakland and adjacent Edge Cities.

The Interactive Megalopolis

To achieve significant productivity gains in the Knowledge Based Society in places as different as Ottawa, Canada and Silicon Valley, the urban form will have to evolve again to expand its reach. Just as the industrial age gave birth to the metropolis, consolidating villages and towns, the Interactive Megalopolis will consolidate adjacent metropolitan regions and their Edge Cities into a single local labour force for resident new economy industries. Both telecoms and a new form of transportation will play vital roles in this expansion. While longer daily commutes will be possible, a significant number of workers will choose to work in satellite offices or in their homes, but, when the need arises, will be able to use a new means of transportation to commute between metropolitan regions like Sacramento, the Bay Area, the Central Valley and Silicon Valley or, indeed, between Paris and London.

Necessary Transportation Attributes to Link Metropolitan Regions

Factors that impede travel between metropolitan regions can be compared to the 'Friction Resistance' in pipes that carry water from source to receptor. The properties of the pipe determine the speed and efficiency of transmission and its effective capacity. To create the Interactive Megalopolis, the transportation technology will need to peel away as many of the travel inhibitors as possible to convert existing intercity markets into intracity mass transportation markets.

Today no transportation mode offers the travelling public the service attributes that can provide the necessary urban interaction to link metropolitan regions together to achieve a shared urban agglomeration of knowledge workers. Air travel does provide increased accessibility but for many reasons in addition to cost and capacity, its service attributes

10. *Joel Garreau, "Edge City", Doubleday Books, 1991.*

cannot easily serve the 'mass commuter' market, despite the improvements achieved by low-cost commuter airlines. And the automobile is largely limited to a commuter time duration of 60 minutes; depending on congestion levels, roughly 30 to 50 miles door to door.

A successful transportation mode will be one that can emulate the airlines' inter-city travel time (for distances up to 200 miles) as well as the cost-convenience-ease of use-time reliability of an intra-urban mass transit service. Its needed attributes are:

Attributes Neccessary for a Successful Tranportation Mode

Speed: A system capable of sustained operating speeds in excess of 200 miles per hour or more, which for markets up to 200 miles is as fast as regional airlines.

Station Locations: Should the transportation mode be a collective ground system, the number and location of stations is critical in the development of a long-distance commuter service. A commuter service from Silicon Valley to Oakland, Berkeley or even the Central Valley and Sacramento would have to serve many stations in order to reduce the time needed to get to and from the stations.

Service Convenience: The mode must be designed to match several user-friendly service attributes from 'intra-urban' transit modes, that is: high frequency, ease of use; ease of access; ease of information provision; ease of ticketing (ideally, no paper ticketing); ease of passenger processing; and a simplified fare structure.

Safety and Security: The system would have to offer significant safety and security improvements over automobile travel and match or surpass the safety record of mass transit.

Confidence: An 'intra-urban' transportation system (whether highway expressways or public transit), to function effectively, must inspire the total confidence of the travelling public. Travellers must be assured that when they need to travel, they will always have the transportation system available.

Capacity: In contrast to commercial intercity transportation operations, sufficient capacity levels must be provided to assure passengers of a continual availability of service, similar to the operation of existing subways that commonly have an hourly capacity upwards of 25,000 to 30,000 passengers.

Costs: The price of a Sacramento – Silicon Valley trip ought to replicate or better the cost of a cross-town taxi fare in Silicon Valley. The likely fare for the BART Airport Shuttle service that will also be used by airport employees from downtown San Francisco will be about US$25.

Environmentally Benign: To the extent possible, the transportation technology should be environmentally benign.

Meeting the Necessary Transportation Attributes

Two new technologies under development are aimed at meeting the above transportation attributes: the Automated Highway System and Maglev. Of these two, Maglev appears to be the nearer-term solution.

The Automated Highway System was designed to alleviate congestion on America's freeways by eliminating differential speeds and freeway incidents with the introduction of automated guide-ways to govern vehicular control. While the technology would allow a vehicle to reach a distance of 120 miles in 90 minutes and double or triple vehicle freeway capacity, technical barriers remain. The US Department of Transportation has scaled back this programme, now known as the Intelligent Vehicle Initiative to consolidate short-term technical advancements in vehicle controls to improve road-vehicle safety.[11]

Maglev projects are in an advanced stage of development in both Europe and Japan, and new designs, optimised for the intracity market are proposed. In 1990, the US Department of Transportation, the US Army Corps of Engineers and the Department of Energy jointly sponsored a study to develop a National Maglev Initiative. One of four technologies studied was specifically designed to transport a high volume of passengers from numerous offline stations, at a very low cost. If constructed between Sacramento, Silicon Valley, the Central Valley, and points in between, it would be able to transport a commuter to Silicon Valley from Sacramento in 30 minutes at a cost that is significantly less than the BART Airport Shuttle. While the operating cost of this maglev system is low, the capital costs are significant, in the range of US$30 to US$50 million a linear mile, depending on the topography. These per-mile costs are, however, much less than those projected for the new BART extension.[12]

Unfortunately, the National Maglev Initiative Report, while admirable technically, failed to recognise the major potential benefit of such a

11. *S Shladover,* Progressive Deployment Steps Leading Toward an Automated Highway System (AHS), *2000 Transportation Research Board Annual Meeting, Washington, Paper No. 00-0835.*

system. While the report confirmed that the technology was feasible, it stated that inter-metropolitan maglev service was not economically feasible given the limited current volume of traffic with the exception of the Northeast corridor, and possibly, California. The error made was to base projections solely on diversions of existing air and auto inter-city travel. The report ignored the market potential of longer distance inter-metropolitan commuting, such as between Silicon Valley and communities in the Central Valley, distant Edge Cities and Sacramento. Even more important, the report ignored the merging of metropolitan regions that such a low-cost, high-speed transportation service could provide for, thus resolving the conflict between employment growth and quality of life.

Conclusion

Our urban form is experiencing its greatest transformation since the early industrial age. The simultaneous deployment of advanced transportation and telecoms systems will expand urban 'commuter-sheds' giving birth to the Interactive Megalopolis. The impact of the resulting increase in labour accessibility will provide new agglomerations of urban economies and increase the economies of scale of a highly specialised work-force without incurring congestion conflicts that are affecting the quality of life in such places as Silicon Valley.

Regions that can achieve these new agglomerations while at the same time reducing the environmental, social and economic costs of meeting increased travel demands will prosper in the information age. Those that are less successful will suffer economically in the global competition for knowledge investment.

> *"More companies will become footloose – more willing to locate wherever the best bargain of skills and productivity can be had."*
>
> Frances Cairncross,
> The Economist, *The Death of Distance*[13]

While telecoms advancements seem assured, we have yet to begin addressing the transportation requirements of the Interactive Megalopolis. The conversion of an intercity metropolitan travel market into travel time-cost-reliability-convenience equivalent intracity mass transit market, will require much more than simply an increase in speed. Current efforts to promote high-speed trains fall short in providing the necessary attributes of convenience, low fares, and sufficient capacity. A second-class walk up fare for a London/Paris Eurostar TGV return trip is 2,400F or US$352.[14] If we want to build a new urban form that will allow workers in London to live in Paris, we must explore how we can extend the Paris Metro to the London Underground rather than limiting our sights by building a faster intercity railroad. ■

12. *US Deptartment of Transport & US Army Corps of Engineers, Final Report on the National Maglev Initiative, Washington, D.C., Sept., 1993.*
13. *Frances Cairncross,* Death of Distance*, Harvard Business School Press, Boston, 1997*
14. Eurostar Timetable and Fares*, Spring, 2000.*